CLAIMS

What is claimed is:

1. A method for fabricating a nanotube, comprising:

forming a nanowire;

depositing at least one sheath of material over said nanowire; and

removing said nanowire;

wherein said remaining sheath material comprises said nanotube.

2. A method as recited in claim 1, wherein said nanowire is sacrificed during said removal step.

3. A method as recited in claim 1, wherein said nanowire comprises a sacrificial template for forming said nanotube.

4. A method as recited in claim 1, wherein said nanowire is formed as a single-crystalline nanowire structure.

5. A method as recited in claim 1, wherein said nanotube is formed from a single-crystalline sheath structure.

6. A method as recited in claim 1, wherein said nanowire comprises a material selected from the group of materials consisting essentially of zinc oxide (ZnO), silicon (Si), gallium nitride (GaN), germanium (Ge), silver (Ag), gold (Au), group II - VI materials, group III - V materials, elemental group IV materials, and metals.

7. A method as recited in claim 6, wherein said sheath comprises a material selected from the group of materials consisting of gallium nitride (GaN), silicon oxide (SiO_2), group II - VI materials, group III - V materials, elemental group IV, metals, oxides of the preceding materials, dopants introduced in the preceding materials, and polymers.

8. A method as recited in claim 7, wherein the material selected for said nanotube sheath has a sufficiently similar crystalline structure and lattice constant as the material selected for said nanowire to allow epitaxial growth of said sheath on said nanowire.

9. A method as recited in claim 1, wherein said sheath comprises a single longitudinal segment covering said nanowire.

10. A method as recited in claim 1, wherein said sheath comprises multiple longitudinal segments covering said nanowire.

11. A method as recited in claim 10, wherein said multiple longitudinal segments are formed utilizing masking techniques.

12. A method as recited in claim 1;

wherein an array of said nanotubes is fabricated by depositing sheaths over an array of nanowires;

wherein said array is formed upon a substrate.

13. A method for fabricating a nanotube, comprising:

forming a sacrificial nanowire template of zinc oxide (ZnO);

depositing at least one sheath of gallium nitride (GaN) over said nanowire; and

removing said nanowire;

wherein said sheath comprises a gallium nitride (GaN) nanotube structure.

14. A method as recited in claim 13, wherein said nanowire comprises single-crystalline zinc oxide (ZnO).

15. A method as recited in claim 13, wherein said gallium nitride (GaN) sheath is deposited over said nanowire by epitaxial casting.

16. A method as recited in claim 15, wherein said epitaxial casting

comprises gallium nitride (GaN) chemical vapor deposition.

17. A method as recited in claim 16:

wherein trimethylgallium and ammonia are used as precursors to said chemical vapor deposition and is fed with argon or nitrogen carrier gas;

wherein said chemical vapor deposition of GaN is performed at approximately six hundred degrees Celsius (600 °C) to seven hundred degrees Celsius (700 °C).

18. A method as recited in claim 13:

wherein said gallium nitride (GaN) nanotube has an inner diameter which is in the range from approximately thirty (30 nm) nanometers to two hundred (200 nm) nanometers;

wherein said gallium nitride (GaN) nanotube has a wall thickness which is in the range from approximately five (5 nm) nanometers to fifty (50 nm) nanometers.

19. A method as recited in claim 13, wherein said nanowire of zinc oxide (ZnO) is removed by subjecting it to elevated temperature in an atmosphere containing hydrogen gas.

20. A method as recited in claim 19:

wherein said elevated temperature comprises approximately six hundred degrees Celsius (600 °C);

wherein said atmosphere comprises approximately ten percent (10%) hydrogen gas in an argon gas atmosphere.

21. A method as recited in claim 13, wherein said nanowire of zinc oxide (ZnO) is removed by subjecting said array to chemical etching.

22. A method as recited in claim 21, wherein said chemical etching comprises ammonia etching at sufficiently elevated temperature for removal of said zinc oxide nanowire.

23. A method for fabricating a nanotube, comprising:

forming a sacrificial nanowire template of a first material;

forming a sheath of modified said first material over said nanowire; and

removing said nanowire;

wherein said sheath is a nanotube structure.

24. A method as recited in claim 23, wherein said nanowire comprises a single-crystalline material.

25. A method as recited in claim 23, wherein said sheath is formed on said nanowire by thermal oxidation.

26. A method as recited in claim 23, wherein said nanowire is removed in an etching process.

27. A method as recited in claim 23:

wherein said first material comprises silicon (Si);

wherein said modified first material comprises silicon oxide (SiO_2).

28. A method as recited in claim 27, wherein said sheath is formed on said nanowire by a thermal oxidation process in which temperature determines the thickness of said sheath.

29. A method as recited in claim 28, wherein the temperature of said thermal oxidation is in the range of from approximately eight hundred degrees celcius (800 °C) to approximately one thousand degrees celcius (1000 °C).

30. A method as recited in claim 29, wherein said nanowire is removed in an etching process comprising:

covering the combination of said sheath and nanowire with an etch-resistant material;

removing the top end of the sheathed nanowire while the sheathed walls of said nanotube are protected by said etch-resistant material;

removing the silicon (Si) nanowire material from within said silicone oxide (SiO_2) nanotube; and

removing said etch-resistant material.

31. A method as recited in claim 30, wherein said etch-resistant material comprises a dimer or polymer.

32. A method as recited in claim 31, wherein said etch-resistant material comprises perylene.

33. A method as recited in claim 30, wherein said removing the top end of said sheathed nanowire comprises:

etching in oxygen plasma to remove sufficient depth of said etch-resistant material to expose said sheathed nanowires; and

etching in hydrofluoric acid to remove the metal cap of said nanowire.

34. A method as recited in claim 33, wherein said removal of the silicon (Si) nanowire comprises etching in xenon flourine (XeF2).

35. A method as recited in claim 30, wherein removal of said etch resistant material comprises oxygen plasma etching.